Ezecal Model 6

User Manual

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1 Introduction

The Ezecal Model 6 is a general-purpose tool intended for the calibration of control equipment, instrumentation and transducers. It can both simulate and measure simultaneously and provides galvanic isolation between its output and input.

The Ezecal Model 6 is a high precision instrument, and as such must be recalibrated regularly (at least once per year) to maintain optimum performance. For the users convenience, the date of the last calibration is shown on the display every time the unit is switched on.

1.1 Battery pack

The Ezecal is equipped with an interchangeable, rechargeable NiMH battery pack providing up to 20 hours of continuous use.

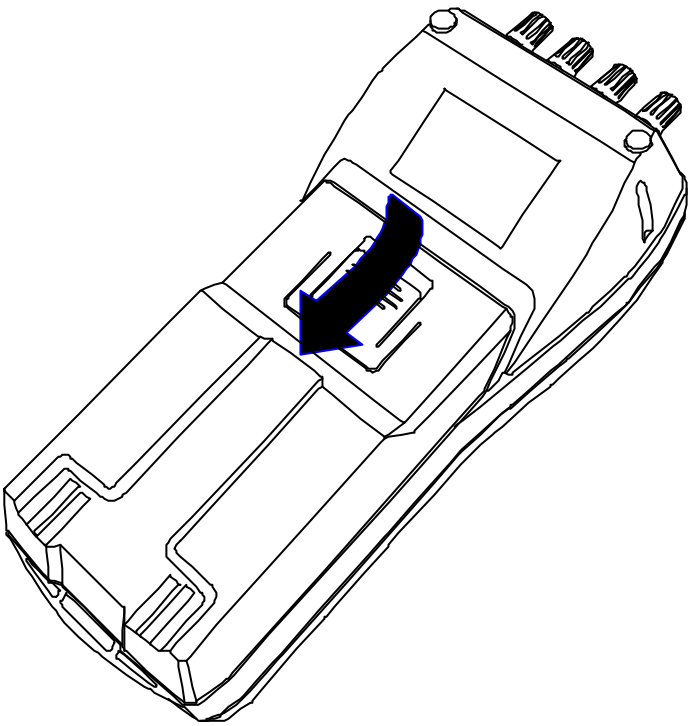
When the Ezecal detects that the battery is low on power, the battery condition indicator will flash and the unit will start to beep. After a short time the unit will switch itself off. At this point the battery pack should be recharged.

To remove the battery pack simply press down the release tab and slide the pack backwards for approximately 10mm.

When the battery pack is disconnected from the unit take care not to short out the power contacts

Plug the battery pack into the fast charger unit; this will take up to 4 hours to fully charge the battery.

To refit the pack, simply follow the reverse procedure.

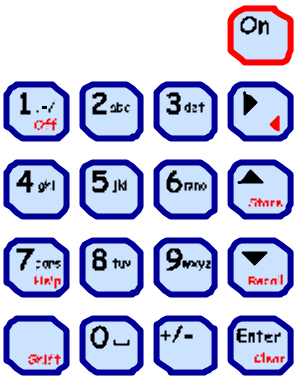


Warning
Removal of the battery pack while the unit is switched on may result in some memory loss. Always ensure that the unit is switched off before changing the battery pack

2 Operation

2.1 The keypad

The keypad consists of 16 tactile keypads plus an **On** button.



The keypad legends in black show the purpose of the key when used in isolation.

The red legends are the shift functions. To use a shift function, hold down the shift key first and then press the required key.

For example, to activate the **Help** function, hold down the **Shift** key and then press the **7** key.

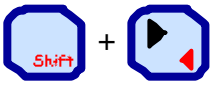
Every time a key is pressed the display backlight will illuminate and the unit will emit a short beep. The backlight will go off after a preset length of time to preserve battery life.

2.1.1 The Scroll key

The right arrow key is a special key called **Scroll.** This key is used to select the next screen in a sequence

To advance to the next screen

Alternatively, when used in conjunction with the **Shift** key, the user may return to the previous screen

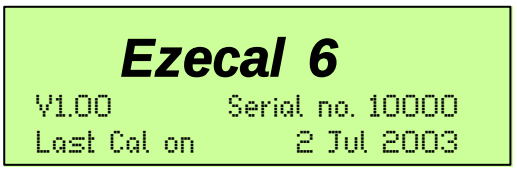


To return to the previous screen

2.2 Turning the unit on and off

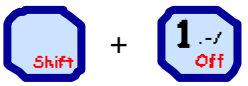
To turn on the unit simply press the **On** key. The power up logo display will be shown. This display shows the date that the unit was last calibrated. Check that this is less than one year ago.

To turn on the unit



The unit will switch itself off if no keys are pressed for a set period of time. This time may be set by the user from the **Options menu** . The Ezecal gives the user 10 seconds warning that it is about to switch off. This is signified by 10 beeps at one-second intervals, the beeps increasing in length each time. To prevent switch off, simply press any key.

Alternatively, the unit may be switched off immediately by holding down the **Shift** key and pressing **1**.



To turn off the unit

2.3 Entering numbers

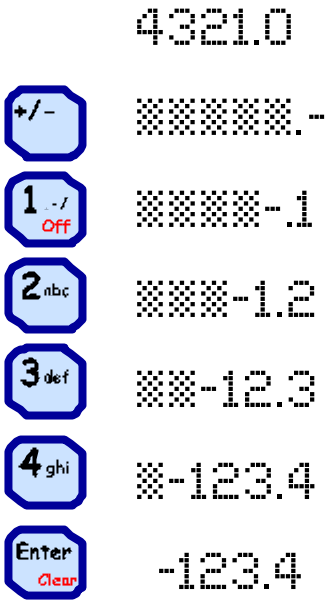
The numeric keypad is used to enter numeric data in exactly the same way as a calculator. Numbers are entered exactly as written followed by the **Enter** key.

The decimal point position is taken care of automatically depending on the range selected.

Each time a valid key is recognised the Ezecal will emit a short beep.

If a number that is outside the valid range is entered, the unit will emit a long beep and the number will return to its previous value.

To cancel the current entry, press the **Clr** key (**Shift+Enter**) and the number will return to its previous value.



Alternatively, the displayed number may be driven up or down using the **Up** or **Down** arrow keys. As the key is pressed and held down, the displayed number changes slowly at first and then increases in speed up to its maximum of approx 500 digits per second.

2.4 Connections

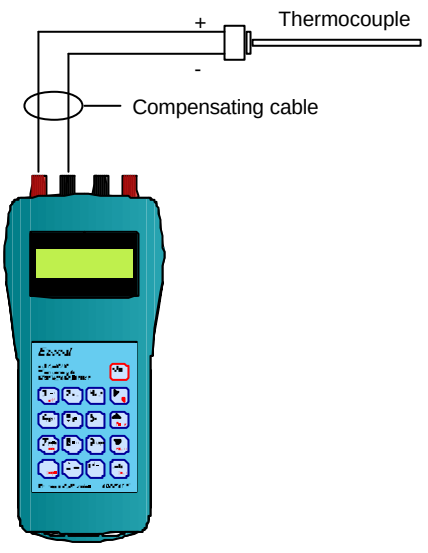
All connections are made to the unit via the four 2mm binding posts at the top of the unit.

2.4.1 Thermocouple measurement

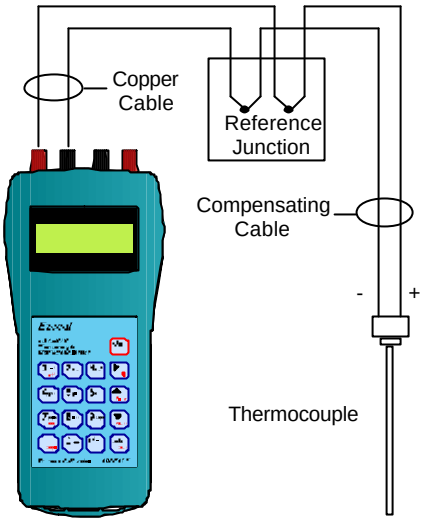
There are two modes of thermocouple measurement available depending on the location of the reference (cold) junction.

For thermocouples wired in compensating or extension cable, the wires should be directly connected to the measurement terminals on the Ezecal 6. For best results, the bare wires should be tightly clamped under the terminals rather than using plugs. Avoid handling the wires or the terminals as much as possible as this tends to warm them up and may introduce measurement errors.

When the thermocouple is connected in this manner the Ezecal measurement reference junction mode should be set to **Automatic**.



Alternatively an external reference junction may be used. In this case the cables from the reference junction should be connected as shown and the Ezecal measurement reference junction mode should be set to **Manual**, The temperature of the reference junction should be entered as the reference temperature.

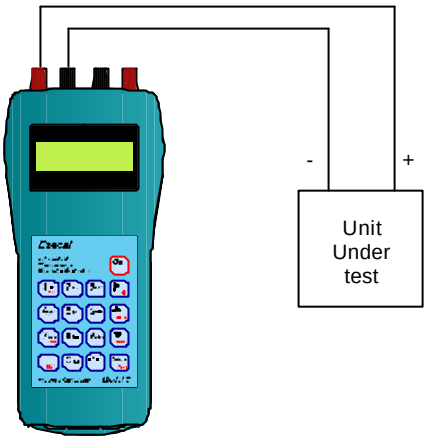


2.4.2 Voltage measurement

Connect the voltage source directly to the Ezecal as shown.

Select the 100mV or 10V measuring range as appropriate.

For low level voltage measurement please see section XX for hints on accurate measurement

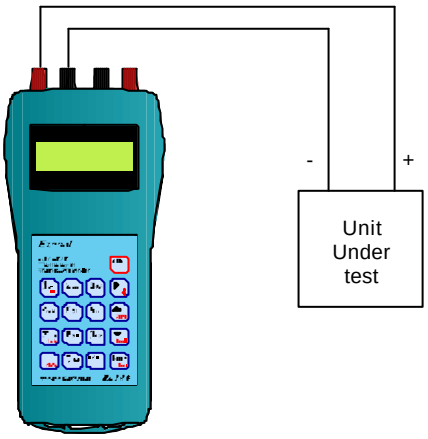


2.4.3 Current measurement

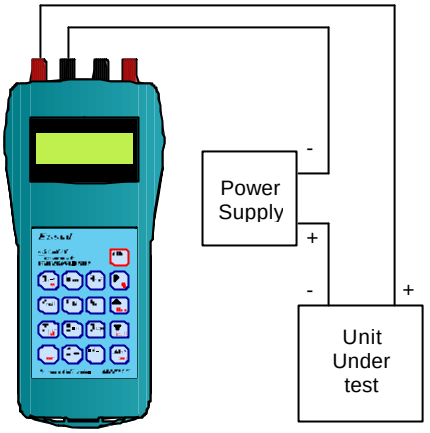
Devices in the field which source current (such as controller outputs and powered transmitters) may be measured by connecting them directly to the Ezecal as shown.

Select the 20mA measuring range.

The Ezecal 6 uses a 5 Ohm current measuring shunt and hence only drops 100mV at 20mA



Other devices (such as loop powered transmitters) are only capable of sinking current and hence require a power supply in order to work. For these devices a power supply should be wired in series with the current loop.

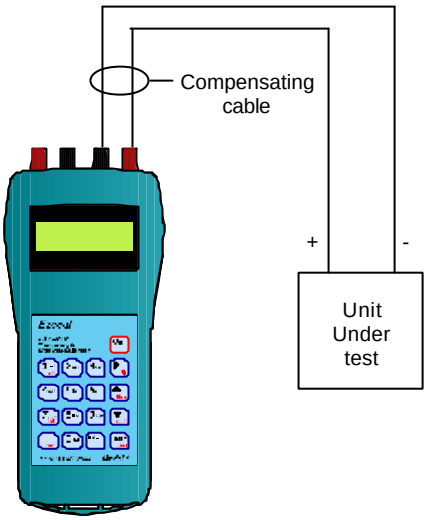


2.4.4 Thermocouple simulation

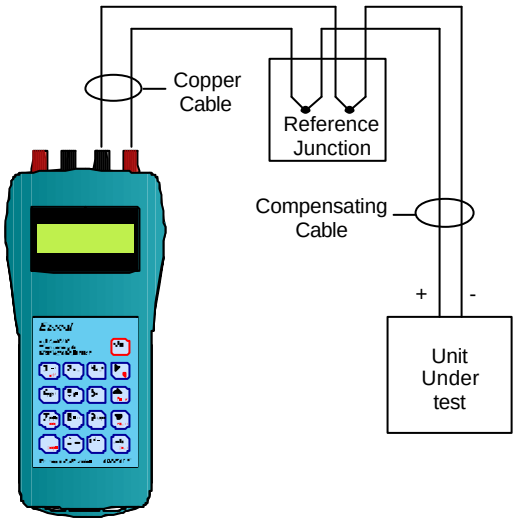
There are two modes of thermocouple simulation available depending on the location of the reference (cold) junction.

For connection in compensating or extension cable, the wires from the unit under test should be directly connected to the simulation terminals on the Ezecal 6. For best results, the bare wires should be tightly clamped under the terminals rather than using plugs. Avoid handling the wires or the terminals as much as possible as this tends to warm them up and may introduce measurement errors.

When the unit is connected in this manner the Ezecal simulation reference junction mode should be set to **Automatic**.

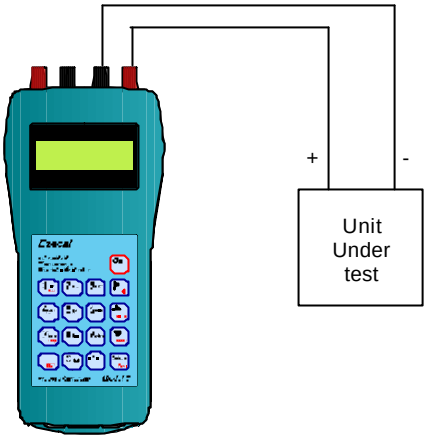


Alternatively an external reference junction may be used. In this case the cables from the reference junction should be connected as shown and the Ezecal simulation reference junction mode should be set to **Manual**, The temperature of the reference junction should be entered as the reference temperature.



2.4.5 Voltage and current simulation

Connect the unit under test directly to the Ezecal as shown.



Select the 100mV ,10V or 20mA simulation range as appropriate.

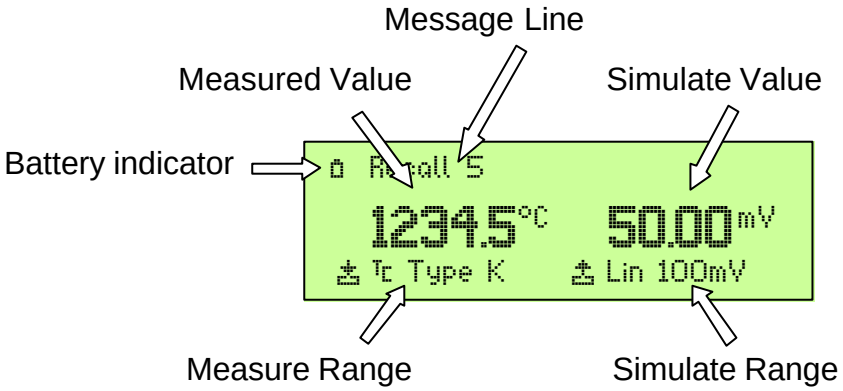
For low level voltage simulation please see section XX for hints on accurate simulation.

When simulating in current mode, the Ezecal provides loop power.

2.5 Operating displays

2.5.1 The default display

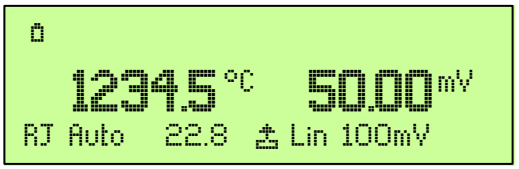
The default display is the normal display screen that is shown for measurement and simulation.



The measurement value, range and units are shown on the left (opposite the measurement terminals) and the simulated value is show on the right.

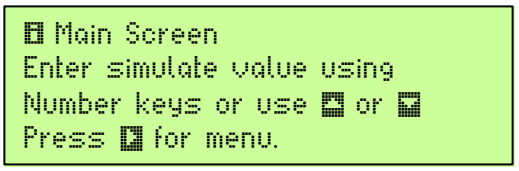
Enter the simulation value required at any time using the numeric keys, or use the Up and Down arrow keys.

For thermocouple ranges the current reference junction mode and temperature can be displayed by holding down the Shift key. The bottom line of the display will then change to show the appropriate values.



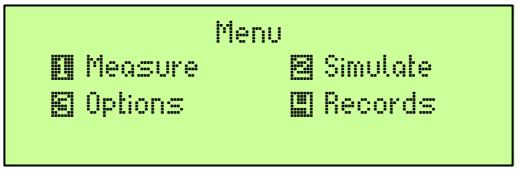
From this screen the main menu screen can be invoked by pressing the **Scroll** key. Any menu function will automatically time out after 20 seconds if no keys are pressed.

Press the **Help** key (Shift 7) to access brief help for the current screen
Press any key to exit the help screen or wait for 10 seconds and it will time out.

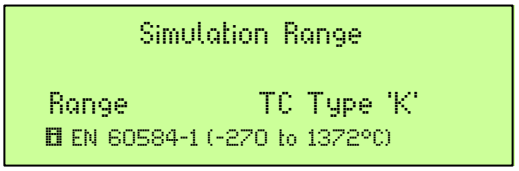


2.5.2 Changing Range

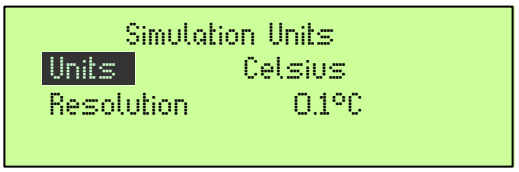
From the default display press the **Scroll** key and the main menu will appear. Press **1** to select the measurement range or **2** to select the simulation range as required.



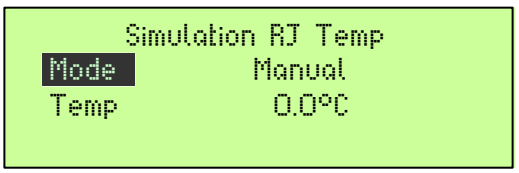
The currently selected range will be displayed along with the range standard and limits on the bottom line of the display. Use the up and down keys to change the range as required.



Press the scroll key to advance to the units selection screen. Press **Shift** and **+/-** to select either the units or the resolution as required. Again use the up and down keys to select the units of your choice. Note that linear ranges have fixed units and thus cannot be changed.



Press the scroll key to advance to the reference junction selection screen.
Press **Shift** and **+/-** to select either the reference mode or the reference temperature as required. To change the reference mode , use the up key to select **Automatic** or the down key to select **Manual**



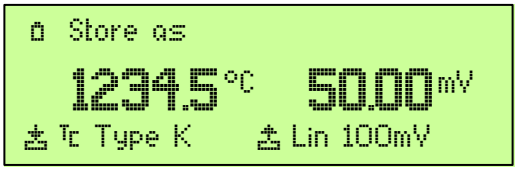
The reference junction mode is only applicable to thermocouple ranges. In automatic mode the Ezecal uses its internal temperature sensor to apply cold junction compensation to the input or output. This mode is applicable when the unit is wired in compensating or extension cable.

In manual mode, the Ezecal assumes that the reference (cold) junction is external to the unit and it is up to the user to enter the temperature of this junction as appropriate. Use the numeric keys to enter the temperature in the selected units. Alternatively use the up and down keys to drive the displayed value to the temperature required.

Press the **scroll** button to return to the main menu.

2.5.3 Saving and recalling frequently used values

The Ezecal 6 has ten memories in which simulate values can be stored. These may be used to store frequently used output values (such as 0 and 1000).

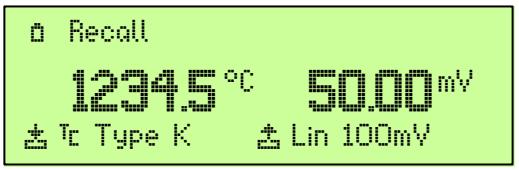


To store a value in memory, first of all enter the

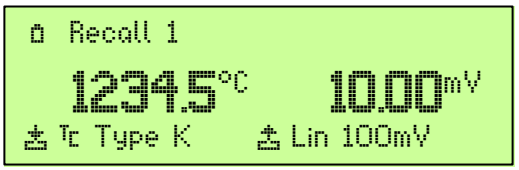
simulate value as normal (for example 100.0). Then press the **Store** key (Shift Up arrow). The display will indicate on the top line that a store is in progress.

Now press a numeric key appropriate to the memory in which you wish to store the value. The value will be stored in the selected memory.

To recover a value from memory, press the **Recall** key (Shift Down arrow). The top line of the display will indicate that a recall is in progress.

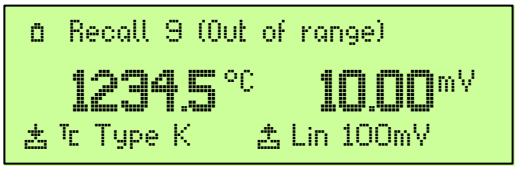


Press the number key corresponding to the memory that you wish to recall and the value from the memory will be used as the current simulation value. Press another number to recall from a different memory.



The user may cycle through all the values in memory by using the **Up** arrow key to select the next memory, or the **Down** arrow key to select the previous memory.

If the value stored in a selected memory is not suitable for the current simulation range then the value will not be used and an error message is displayed.



To cancel recall mode simply press the **Recall** key (Shift Down arrow) again.

2.5.4 Timed recall of saved values

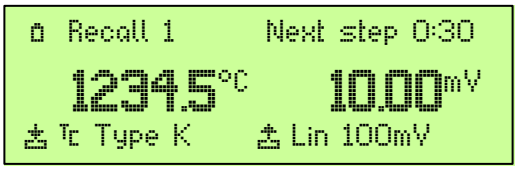
There are occasions when it is useful to recall stored values automatically at regular intervals. For example if the Ezecal 6 is being used to check the calibration of a device with a remote display, it may be inconvenient for the user to manually select the simulate values. In this case the Ezecal 6 may be set to recall automatically values previously stored in its 10 memories.

To recall values automatically

See section 2.6.3 Recall timer and set the recall the time base to the value required.

Return to the default display and enter the values required in order into memories zero onwards see section 2.5.3 Saving and recalling frequently used values.

To start the timed recall press the **Recall** key (Shift Down arrow). The current memory number is displayed with the time remaining in minutes and seconds before the next step is invoked.



The user may force the current step by using the **Up** arrow key to select the next memory, or the **Down** arrow key to select the previous memory. Alternatively press the number key appropriate to the memory required. In either case, if the step number is manually forced the step timer is reset immediately.

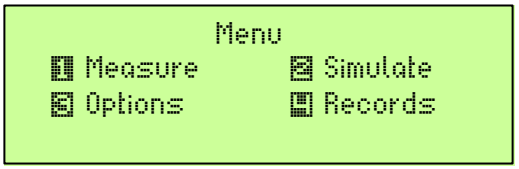
The Ezecal will cycle through all 10 value memories and then return to memory 0. If a zero or out of range value is encountered in the sequence, then the Ezecal will start again at memory 0.

To cancel recall mode simply press the **Recall** key (Shift Down arrow) again.

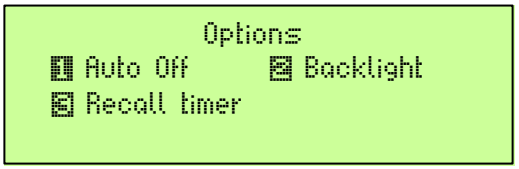
Please note.
The automatic power off feature is disabled while timed recall is in progress.

2.6 Optional settings

To gain access to the optional settings, press the Scroll key from the default screen and the main menu will appear. Press **3** to advance to the options menu.

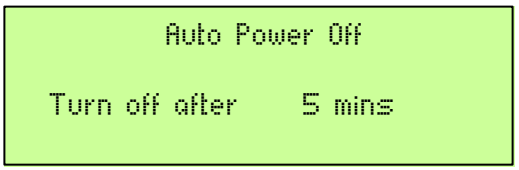


Press keys **1,2 or 3** to select the optional setting required.



2.6.1 Auto power off

In order to preserve battery power the Ezecal will automatically turn itself off if no keys are pressed for a certain time. This time may be set from 5 to 99 minutes using the **Up** and **Down** arrow keys.



The unit will provide 10 seconds warning that it is about to power off by beeping once per second, each beep being longer than the previous. To prevent the unit from switching off simply press any key.

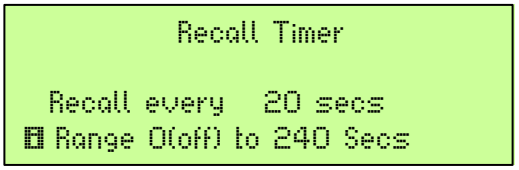
2.6.2 Backlight timeout

The Ezecal is equipped with a display backlight that aids viewing of the display under bad light conditions. In order to preserve battery power the Ezecal will automatically turn off the backlight if no keys are pressed for a certain time. This time may be set from 1 to 60 seconds using the Up and Down arrow keys, or by entering the time required using the numeric keys.

If the backlight is not required, it can be turned off by entering a value of zero.

2.6.3 Recall timer

The Ezecal 6 may be set to recall automatically values previously stored in its 10 memories. See section 2.5.4 Timed recall of saved values. The automatic recall occurs at fixed time intervals which may be set from 1 to 240 seconds using the Up and Down arrow keys, or by entering the time required using the numeric keys.



If the recall timer is not required, it can be turned off by entering a value of zero.

3 Calibration Records

This powerful feature allows many instruments to be calibrated during a day in the field and the results stored within the calibrator. Then, upon return to the office or car, the calibration data may be uploaded to a laptop and calibration certificates printed out and signed.

A calibration record is a file stored within the calibrator which records the before and after calibration performance of an instrument or transmitter. The EZECAL 6 can store up to 10 such files.

Calibration files may be downloaded from a pc or created as required in the actual unit

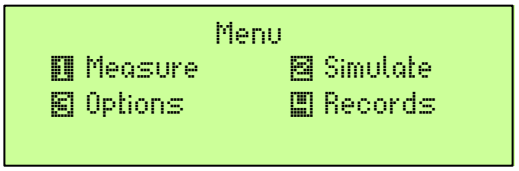
- Create a calibration file or download one from a pc.
- Connect up the item to be calibrated.
- Open the calibration file.
- Select or add calibration points while actually performing the calibration.
- Close the file.

At a later time….

- View the calibration file or upload it back to a pc.
- Erase the calibration file.

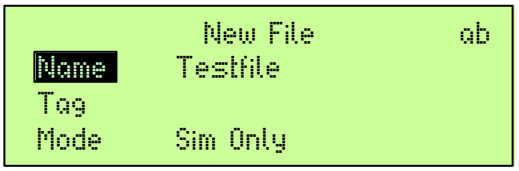
3.1 Creating a new calibration file

From the main menu Press **4** to advance to the **Cal Records** menu.

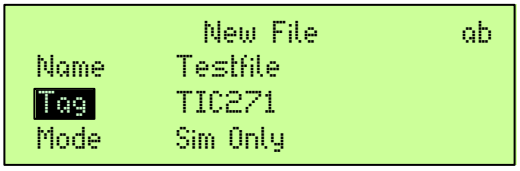


Press **1** to begin creating a new file.

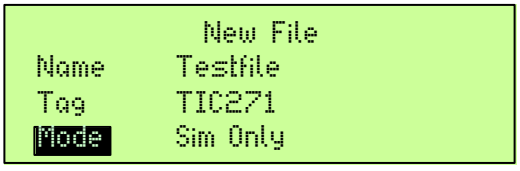
Enter the name of the file required. Use the keypad to enter text in exactly the same way as a mobile phone. Use the Up arrow key to select upper case characters (indicated by the **AB** symbol on the top right of the display) or press the Down arrow key to select lower case characters (indicated by **ab** on the display). Press the enter key when the name is complete. Press **Shift** and **+/-** to select the next field for entry.



Enter the tag name of the device to be calibrated. This may be the serial number or any other characters required. Enter this in the same way as the file name.



Press **Shift** and **+/-** to select the next field for entry.



Select the calibration mode required using the Up and Down keys.
Simulate Only.
In this mode the Ezecal is used to provide the calibration source only. For example when calibrating a temperature indicator, the user needs only to provide an input to the indicator, the value indicated is recorded by the user. Since the performance of the unit under calibration is manually entered the range, resolution and units may entered as required.

Simulate + Measure.
In this mode the Ezecal both provides the calibration source and measures the results. For example when calibrating a temperature transducer, the user needs to provide the input to the transducer and measure the output from the transducer

Press the **Scroll** key to advance to the setup for the simulation output.
Select the required range for the simulation output using the **up** and **down** arrow keys.

Press **Shift** and **+/-** to select the next field for entry.
Select the required units of measure for the simulation output using the **up** and **down** arrow keys.
Note. Not all ranges have selectable units.

Press the **Scroll** key to advance to the setup for the measurement input.

Simulate only mode.
If the calibration mode was earlier set to simulate only, the user is required to specify the units and resolution for the measured values to be manually recorded.
Enter the units of measure using the usual text entry method (3 chars max) and press **Enter** when complete.
Press **Shift** and **+/-** to select the next field for entry.

Enter the required resolution for the measured values using the **up** and **down** arrow keys

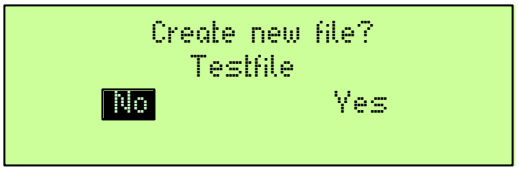
Simulate and Measure mode.
If the calibration mode was earlier set to simulate and measure, the user is required to specify the range and units for the measured input.

Select the required range using the **up** and **down** arrow keys

Press **Shift** and **+/-** to select the next field for entry.

Select the required units for the measurement range.
Note. Not all ranges have selectable units.
Press the **Scroll** key when input is complete.

Finally confirm that you really do wish to create a new file. Select **Yes** or **No** using the **up** and **down** keys and press the enter key to register your choice.

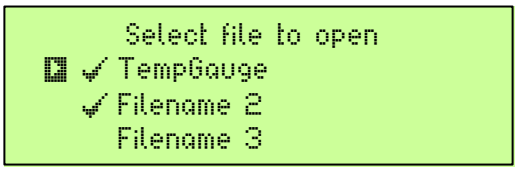


3.2 Opening a calibration file

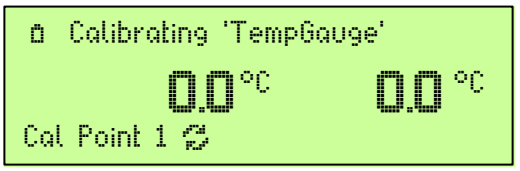
From the main menu Press **4** to advance to the **Cal Records** menu.

Press **2** to open a calibration record file.

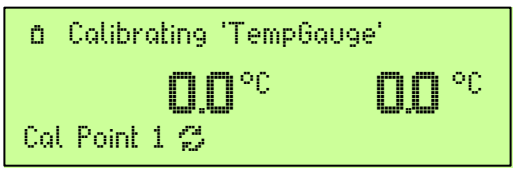
The display will now show the list of files currently available. Files that are complete are marked with a tick. Use the **up** and **down** arrow keys to indicate the file to be opened and press **enter** to open the file.



When the file is opened, the ranges will be set up as specified in the file. Also the first calibration point will be activated and the display will revert to the calibration display.



3.3 Calibration mode display

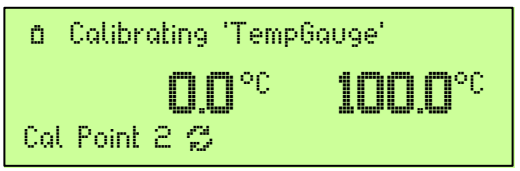


While a calibration file is open the basic display mode of the Ezecal is the Calibration mode display. In this mode the top line of the display shows the name of the calibration file currently open.
The bottom line of the display shows the calibration point currently selected along with a symbol indicating whether this is a check point (◎) or a cal adjust point (⟳).
To select the next calibration value, press the **scroll** key (the previous point may be selected using **shift+scroll**)

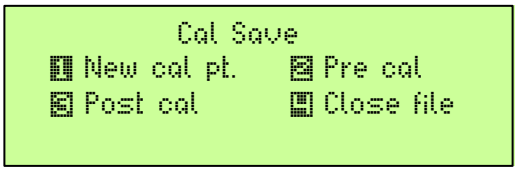
The user may not change range or units while a calibration file is open.

3.3.1 Adding a new calibration point

Enter the new simulation value required using the numeric keypad or the up/down arrow keys in the usual way.

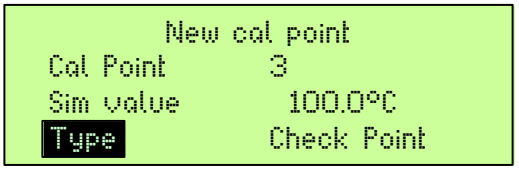


Press the **Store** key (**shift**+**up** arrow) to invoke the Cal Save menu.



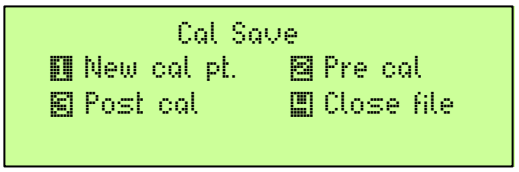
Press **1** to store a new calibration point

Use the **up** and **down** keys to select if this point is a check point or a cal point
Press the **scroll** key to save the new point or back scroll to cancel.

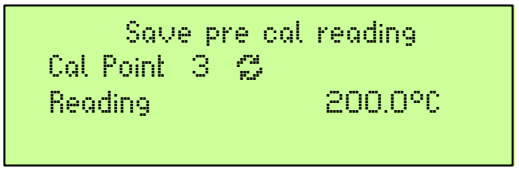


3.3.2 Recording the pre calibration result

Press the **Store** key (**shift**+**up** arrow) to invoke the Cal Save menu.



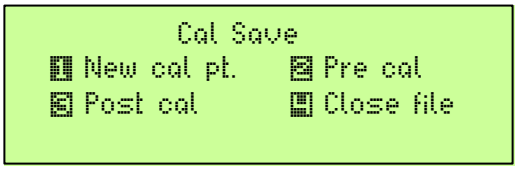
Press **2** to store a pre-calibration value.



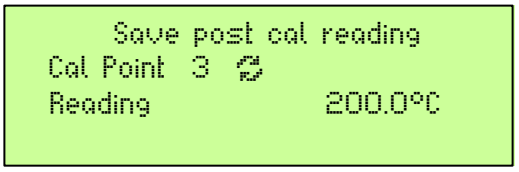
If the calibration mode for this file is set to Simulate and Measure, then the measured value will be entered automatically. For simulate only mode the indicated value on the unit under test should be entered manually via the keypad.
Press the **scroll** key to save the reading or back scroll to cancel.

3.3.3 Recording the post calibration result

Press the **Store** key (**shift**+**up** arrow) to invoke the Cal Save menu.



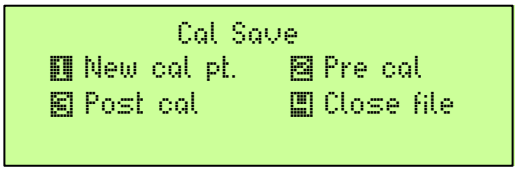
Press **3** to store a post-calibration value.



If the calibration mode for this file is set to Simulate and Measure, then the measured value will be entered automatically. For simulate only mode the indicated value on the unit under test should be entered manually via the keypad.
Press the **scroll** key to save the reading or back scroll to cancel.

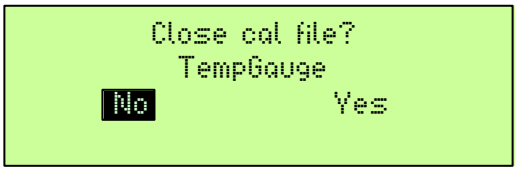
3.3.4 Closing the calibration file

Press the **Store** key (**shift**+**up** arrow) to invoke the Cal Save menu.



Press **4** to close the currently open calibration file.

Finally confirm that you really do wish to close the file. Select **Yes** or **No** using the **up** and **down** keys and press the enter key to register your choice.

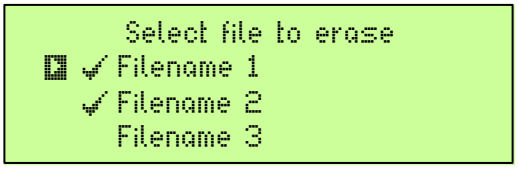


3.4 Erasing a calibration file

From the main menu Press **4** to advance to the **Cal Records** menu.

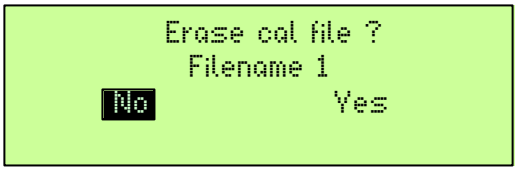
Press **3** to erase a calibration record file.

The display will now show the list of files currently available. Files that are complete are marked with a



tick. Use the **up** and **down** arrow keys to indicate the file to be deleted and press **enter** to select.

Finally confirm that you really do wish to erase the file. Select **Yes** or **No** using the **up** and **down** keys and press the enter key to register your choice.

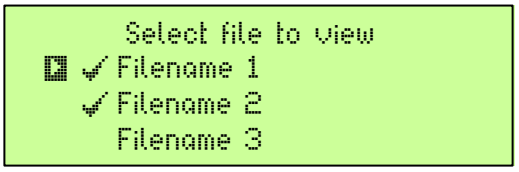


3.5 Viewing a calibration file

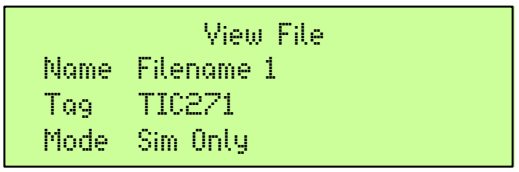
From the main menu Press **4** to advance to the **Cal Records** menu.

Press **4** to view a calibration record file.

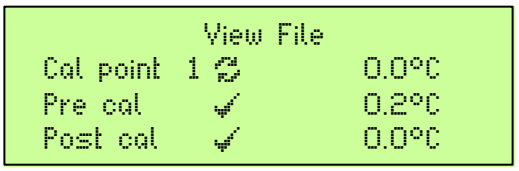
The display will now show the list of files currently available. Files that are complete are marked with a tick. Use the **up** and **down** arrow keys to indicate the file to be viewed and press **enter** to select.



The selected file is then displayed, on the first page the file name, tag name and calibration mode are shown. Press the **Scroll** key to advance to the actual calibration values.



Each calibration point is shown in order. Use the **up** and **down** arrow keys to move through the list as required. For each calibration point, three values are shown.



Cal point. The simulate value used for this point. The adjacent symbol indicates whether this point is a check point (✪) or a cal adjust point (🔄).

Pre cal. The reading given by the unit being calibrated before calibration. If this value has an adjacent tick mark (✓) then this reading has been done.

Post cal. The reading given after calibration. If this value has an adjacent tick mark (✓) then this reading has been done.

Press the **Scroll** key to return to the previous menu..

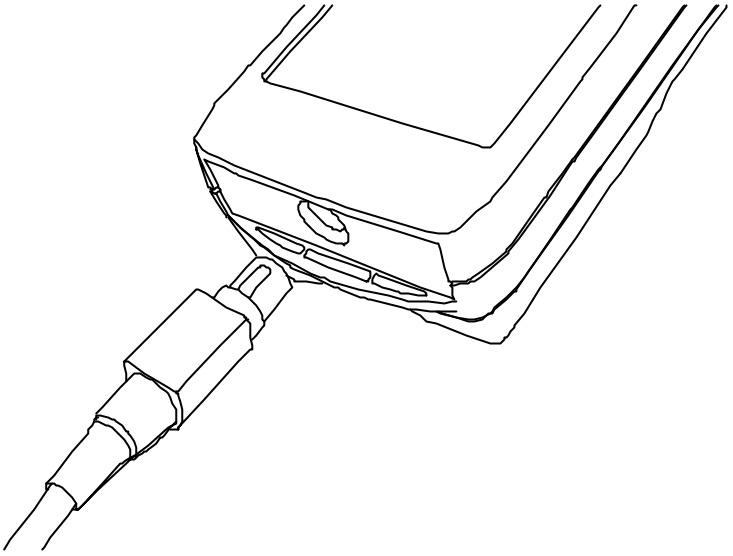
4 Communications

The Ezecal 6 is fitted with an RS232 serial interface as standard and may be used for remote control or downloading of new ranges.

The RS232 port operates at a fixed rate of 57600 Baud, 8 bits per character, one start and one stop bit with no parity.

4.1 Communications connection

The supplied communications lead plugs directly into the unit as shown below. The communications connector is special to the Ezecal 6. Do not attempt to use any other lead.



The other end of the lead is terminated in a standard 9 pin D connector that is suitable for connecting directly into a personal computer or laptop.

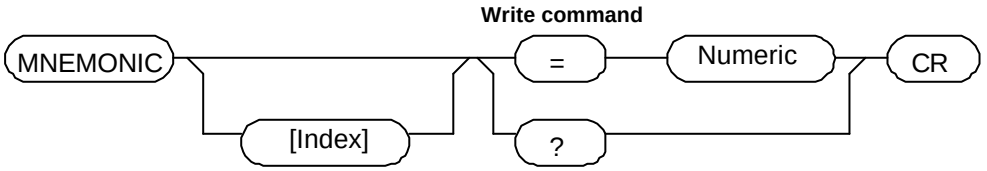
4.2 Command protocol

The Ezecal 6 command protocol is a simple system which allows the user to access the internal parameters within the unit.

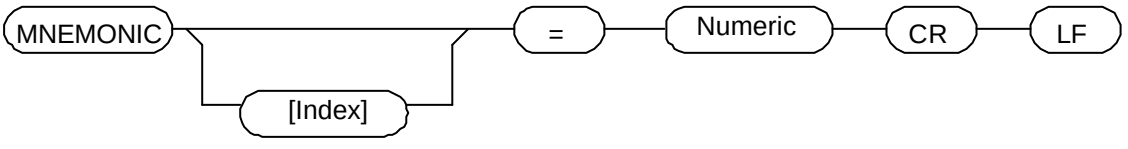
4.2.1 Command syntax

Each Ezecal parameter is identified by a two character mnemonic such as SV (standing for simulate value).

Some parameters are indexed such as the value memories VM, for these parameters the required index number should be sent in square brackets.



Command Syntax



Response Syntax

Every command message uses a two character mnemonic, the mnemonics are listed in the table below.

Mnemonic	Meaning	Writeable	Indexed	Limits
MR	Measured range	Y	N	1 to 14
MV	Measured value	N	N	Depends on range
MU	Measured units	Y	N	Coded
MT	Measured reference junction temperature	Y*	N	-10 to +50°C or equivalent
MM	Measured reference junction mode	Y	N	0=Manual 1=Auto
SR	Simulate range	Y	N	1 to 14
SV	Simulate value	Y	N	Depends on range
SU	Simulate units	Y	N	Coded
ST	Simulate reference junction temperature	Y*	N	-10 to +50°C or equivalent
SM	Simulate reference junction mode	Y	N	0=Manual 1=Auto
VM	Value memory	Y	0 to 9	-9999 to +9999
BT	Backlight timeout	Y	N	0(off) to 60 secs
OT	Auto power off timeout	Y	N	5 to 99 mins
VT	Value memory recall timer	Y	N	0(off) to 240 secs
SN	Serial number	N	N	
VN	Version number	N	N	
CD	Calibration date day	N	N	1 to 31
CM	Calibration date month	N	N	1 to 12
CY	Calibration date year	N	N	2003 to 2099

4.2.2 Examples of messages

In the following examples <CR> should be taken to mean carriage return, ASCII code 13d. <LF> is the line feed character, ASCII code 10d

Read messages

Message	**SV?<CR>**	Read the current simulate value
Response	**SV=1200.0<CR><LF>**	Current simulate value is 1200
Message	**VM[2]?<CR>**	Read the current value of memory 2
Response	**VM[2]=2000<CR><LF>**	Memory 2 contains 2000

Write messages

Message	**SV=100<CR>**	Set the current simulate value to 100
Response	**SV=100.0<CR><LF>**	Unit confirms simulate value is 100
Message	**VM[2]=500<CR>**	Set the current value of memory 2 to 500
Response	**VM[2]=500<CR><LF>**	Unit confirms Memory 2 contains 500

4.2.3 Numeric data

Numeric data is sent to and from the Ezecal in engineering units.

All of the following examples are valid ways of representing the number 5.

5 5.0 5. 05 +5 +05.0 5.000

any of these forms will be accepted by the unit (assuming that 5 is a valid setting for the parameter being accessed)

In certain circumstances the unit will truncate the number received if it exceeds the resolution of the parameter being written. For example on the 100mV simulation range, a received value of 5.001 will be truncated to 5.00. In all cases, the response from the calibrator will confirm the exact value used.

4.2.4 Coded data

Certain command mnemonics return coded data.

Code meanings for **SU** and **MU**

Code	Units
0	Celsius
1	Fahrenheit
2	Kelvin
3	Rankine
4	milliVolts
5	Volts
6	milliAmps

4.2.5 Error messages

If for any reason the Ezecal cannot process the received message, an error message will be returned.

The error message is of the form

Error NNNN<CR>

Where the error code **NNNN** has the following meanings

1 The specified command does exist.
2 An illegal index number was received
4 Unterminated message
8 The command mnemonic does not exist
16 Illegal value received
32 Command mnemonic is read only.

5 Specifications

5.1 Standard Linear ranges

Range		
100mV Input	**Range**	-10mV to +100.00mV
	Accuracy†	±6uV ±200ppm of I/P
	Temp co‡	±0.5uV/K ±40ppm/K of I/P
10V Input	**Range**	-1.000V to 10.000V
	Accuracy†	±600uV ±200ppm of I/P
	Temp co‡	±50uV/K ±40ppm/K of I/P
20mA Input	**Range**	-2.000mA to 20.000mA
	Accuracy†	±600nA ±200ppm of I/P
	Temp co‡	±100nA/K ±40ppm/K of I/P
100mV Output	**Range**	-10mV to +105.00mV
	Accuracy†	±7uV ±200ppm of O/P
	Temp co‡	±0.5uV/K ±40ppm/K of O/P
10V Output	**Range**	-1.000V to +10.500V
	Accuracy†	±750uV ±200ppm of O/P
	Temp co‡	±50uV/K ±40ppm/K of O/P
20mA Output	**Range**	-2.000mA to +21.000mA
	Accuracy†	±1500nA ±200ppm of O/P
	Temp co‡	±100nA/K ±40ppm/K of O/P

Notes

† The accuracy is specified for 90 days after not less than 30 minutes operation under the following reference conditions,
Ambient temperature: 20 ±2°C.
Ambient humidity: 60 ±10%
Power: Internal fully charged batteries, trickle charger not connected.
Backlight: Off
Input source resistance: <100R
Output load resistance: 100R (20mA range) or >10000R (mV and V ranges)

‡ The temperature coefficient is specified under the following conditions:
Ambient temperature: -10 to +50°C ±5°C per hour.
Ambient humidity: 0 to 95%, no condensation.
Source resistance: 0 to 1000R
Load resistance: 0 to 500R (20mA range) or >1000R (mV and V ranges)

5.2 Standard Thermocouple Ranges (European Version)

Range	Standard	Minimum temp	Maximum temp
Thermocouple Type S	EN60584-1	-50°C	1768°C
Thermocouple Type R	EN60584-1	-50°C	1768°C
Thermocouple Type J	EN60584-1	-210°C	1200°C
Thermocouple Type K	EN60584-1	-270°C	1372°C

Thermocouple Type T	EN60584-1	-270°C	400°C
Thermocouple Type E	EN60584-1	-270°C	1000°C
Thermocouple Type B	EN60584-1	0°C	1820°C
Thermocouple Type N	EN60584-1	-270°C	1300°C

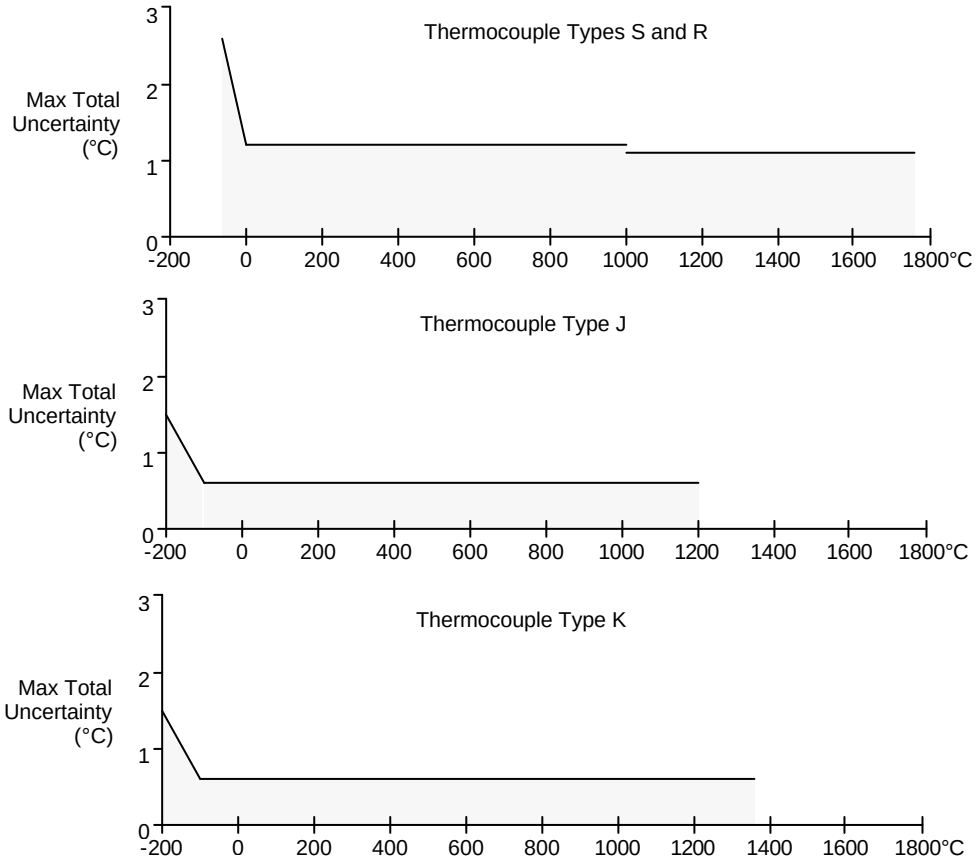
5.3 Standard Thermocouple Ranges (US Version)

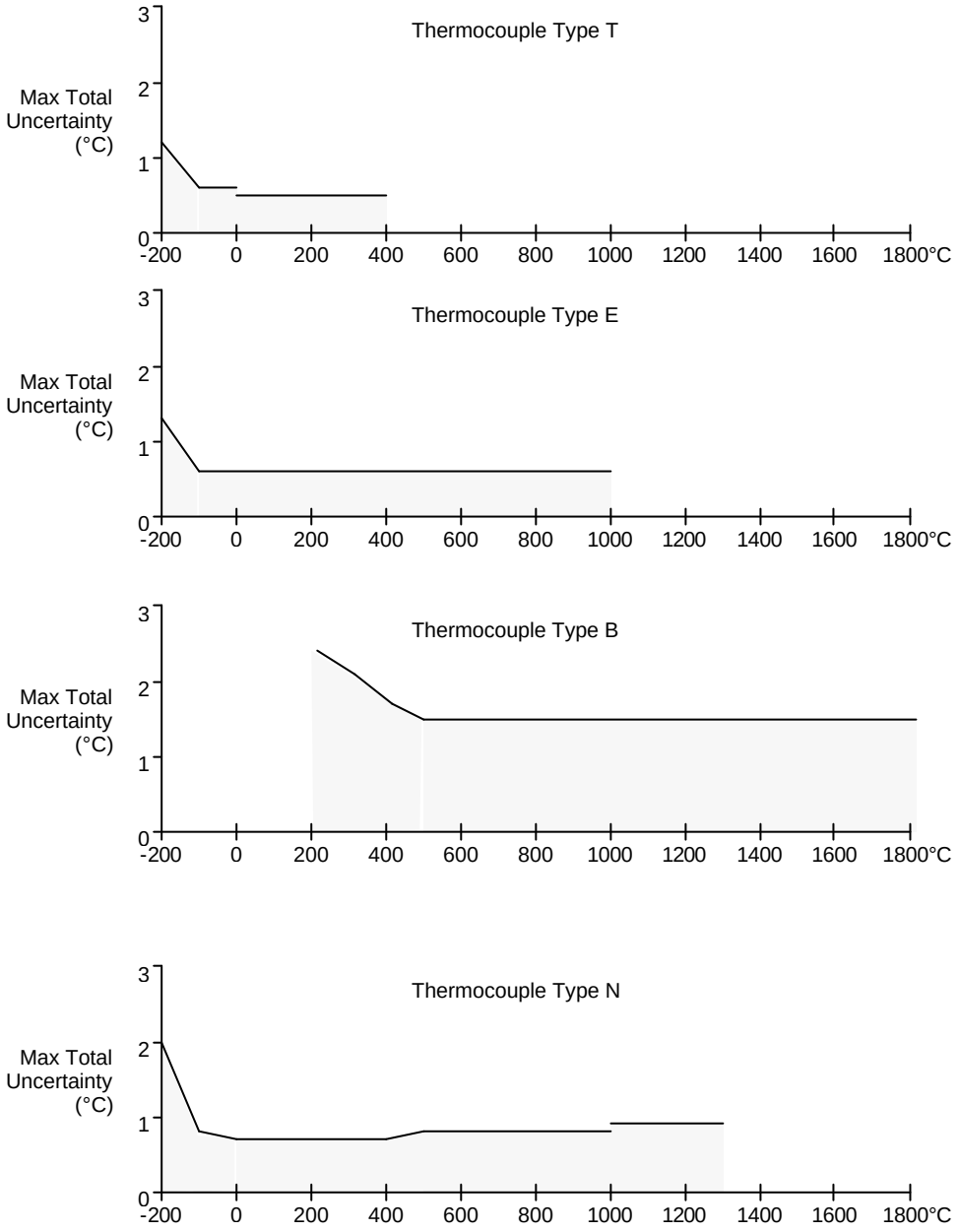
Range	Standard	Minimum temp	Maximum temp
Thermocouple Type S	NIST 175	-58°F	3214°F
Thermocouple Type R	NIST 175	-58°F	3214°F
Thermocouple Type J	NIST 175	-346°F	2192°F
Thermocouple Type K	NIST 175	-454°F	2501°F
Thermocouple Type T	NIST 175	-454°F	752°F
Thermocouple Type E	NIST 175	-454°F	1832°F
Thermocouple Type B	NIST 175	32°F	3308°F
Thermocouple Type N	NIST 175	-454°F	2372°F

5.4 Measurement and simulation accuracy (thermocouple ranges)

The basic accuracy of the 100mV range affects the accuracy of the thermocouple ranges by an amount that varies with type and temperature. To this must be added conformity uncertainties, which vary with type and temperature. To the sum of these is then added the internal CJ accuracy which itself varies with type and temperature.

The following graphs show the absolute max total uncertainties for each of the standard thermocouple ranges





Note that all the base metal thermocouples are very insensitive below –200 and the uncertainty figures are untrustworthy, they are included for illustration only.